Laying the groundwork

Harmonising information on land and soil into an accessible database is a sizeable task. **Vincent van Engelen** discusses Europe's contribution to the development of a global soil observing system

Could you begin by explaining the concept and relevance of e-SOTER?

Soil and land information is needed for a wide range of applications but available datasets is often inaccessible, incomplete, or out of date. The Group on Earth Observation (GEO) plans a Global Earth Observation System of Systems (GEOSS) and, within this framework, the e-SOTER project addresses the need for a global soil and terrain database. As the European contribution to GEOSS, it will deliver a web-based regional pilot platform with SOil and TERrain (SOTER) data, methodology, and applications, using remote sensing to validate, augment and extend existing data. The project has two major research thrusts. The first looks at improving the current SOil and TERrain (SOTER) methodology at scale 1:1 million in four windows in Europe, China and Morocco. Moderate-resolution optical remote sensing will be combined with existing parent material and geology and soil information, making use of advanced statistical procedures. The second seeks to develop advanced remote sensing applications within 1:250,000-scale pilot areas, including geomorphic landscape analysis, geological reclassified remote sensing, and remote sensing of soil attributes.

How does the SOTER methodology differ from previous models, such as that used in the FAO-Unesco Soil Map of the World?

The only harmonised global soil information is the FAO-Unesco Soil Map of the World (SMW) at a scale of 1:5 million (FAO-Unesco 1974-1981). This map has been based on soil surveys executed before its publication date. Mapping unit information is limited to soil names and information on topsoil and subsoil texture, and three slope classes. A much improved methodology for a World Soil and Terrain database (SOTER) incorporates quantitative information (up to 100 items) on both soils and terrain and these quantified soil attributes are linked to the mapping units and allow running of models. Information of SOTER and other sources has been added to the SMW to the recently published Harmonized World Soil Database (FAO/IIASA/ISRIC/ISSCAS/JRC, 2009)

As you mention, e-SOTER takes advantage of advanced technologies such as moderate-resolution optical remote sensing. Can you elaborate on some of these; what do they contribute to the project?

In areas where soil parent material datasets are only available for parts of the mapping area, moderate-resolution optical remote sensing has been used. Multi-temporal images of MODIS bands were compiled into a 55-layer image representing the visible, NIR, MIR and thermal bands. The images also capture the temporal environmental conditions and changes that reveal surface conditions and therefore soil and parent material properties, such as speed of wetting and drying out, cooling down or warming up, which are parameters strongly correlating with the texture, colour, water content and water holding capacity. However, the 55 layers have a significant portion of information overlap; hence a principal component analysis (PCA) was used to decrease the number of input images. The best 15 PCA components were maintained and incorporated into the final image. From these images the following products were generated: a supervised classification into consolidated and unconsolidated soil parent material using training data from areas where such information is known and a soil texture classification using training data and expert knowledge.

Can you highlight some of the difficulties in establishing a comprehensive soil observing system?

Firstly, landform classification based on digital elevation models (DEMs) is still in its initial development and results are not yet universally applicable. e-SOTER is developing methods that will use natural breaks in the landscape slopes.

In addition to this, available DEMs contain artefacts and noise that influence their quality. e-SOTER has developed methods to remove these artefacts and reduce the noise. Remote sensing of soil properties is restricted by the vegetation cover: it is more successful on bare surfaces such as fallow land or semi-arid areas. Legacy soil data has been collected using a range of methods and therefore soil classification methods are not standardised. The remedy is to use a taxonomic neighbourhood method to translate into a global soil taxonomic system World Reference Base for Soil Resources (WRB).

Meanwhile, datasets from local organisations are generally not provided in an OGC compliant interoperable way at present. A system needs to be implemented that allows either local organisations to host their data in a consistent way at their local premises, or at one central node for any given continent.

Finally, soil data characterisation on private property is often difficult due to restricted access. It is expected that data providers will appreciate the products of the GEOSS task and will see the benefit of contributing to the research.